

WHAT IS CLAIMED IS:

1. A stencil mask comprising:

a membrane forming thin layer comprising:

5 membrane areas, each membrane area including a plurality of pattern areas in which a plurality of apertures that allow permeation of particle beams is formed, and a plurality of non-pattern areas placed between the plurality of pattern areas; and

a border area which limits the membrane areas;

10 a main strut formed on the border area of the membrane forming thin layer to support the membrane areas; and

an auxiliary strut formed on the non-pattern areas inside the membrane areas, the auxiliary strut dividing the membrane areas into a plurality of divided membrane areas and supporting each divided membrane area.

15 2. The stencil mask of claim 1, wherein the auxiliary strut penetrates the membrane forming thin layer.

3. The stencil mask of claim 1, wherein the membrane forming thin Layer comprises a first side opposing the main strut and a second side opposite the first side, and the auxiliary strut has a surface exposed through the second side.

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4. The stencil mask of claim 1, wherein the auxiliary strut extends by a first length from the first side of the membrane forming thin layer and the first length is shorter than a length of the main strut.

5 5. The stencil mask of claim 1, wherein the auxiliary strut overlaps the border area and the main strut.

6. The stencil mask of claim 1, wherein the membrane forming thin layer is made of a silicon layer and the auxiliary strut is made of a material
10 selected from the group consisting of a polysilicon layer, a TiN layer, a Ti layer, and a combination layer made of two or more of these three materials.

7. The stencil mask of claim 1, further comprising a protection layer partially covering the auxiliary strut.

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8. The stencil mask of claim 7, wherein the membrane forming thin layer comprises a first side opposing the main strut and a second side opposite the first side, the second side of the membrane forming thin layer exposes a first surface of the auxiliary strut, and the protection layer does not cover the first
20 surface of the auxiliary strut.

9. The stencil mask of claim 7, wherein the protection layer is made of a material selected from the group consisting of a Ti layer, a TiN layer, a silicon nitride layer, and a combination layer made of two or more of these three materials.

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10. The stencil mask of claim 1, further comprising an oxide layer interposed between the border area of the membrane forming thin layer and the main strut.

10 11. The stencil mask of claim 1, wherein the auxiliary strut has a solid cross section and a columnar shape.

12. The stencil mask of claim 1, wherein the membrane forming thin layer has a first side facing the main strut and a second side partially exposing a first surface of the auxiliary strut, and part of the first surface is recessed such that the auxiliary strut has a "U" shape.

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13. The stencil mask of claim 1, wherein the auxiliary strut is located in the non-pattern areas of the membrane forming thin layer such that the membrane areas are divided into a plurality of divided membrane areas sectioned by a cellblock unit.

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14. A method of manufacturing a stencil mask, the method comprising:

(a) preparing a composite layer, the composite layer comprising:

5 a membrane forming thin layer having a first side and a second side opposite the first side, the membrane forming thin layer comprising a plurality of membrane areas each having a plurality of pattern areas for forming a pattern to be projected by particle beams and non-pattern areas placed between each pattern area, the non-pattern areas including a border area limiting the membrane areas;

10 a substrate having a first side facing the first side of the membrane forming thin layer and a second side opposite the first side; and

an oxide layer interposed between the first side of the membrane forming thin layer and the first side of the substrate;

(b) forming a trench by etching the composite layer in the non-pattern areas from the second side of the membrane forming thin layer;

15 (c) forming an auxiliary strut by filling a support layer inside the trench; and

(d) forming a main strut supporting the membrane area in the border area by removing sections of the substrate included in the membrane areas.

20 15. The method of claim 14, wherein the support layer is made of a material selected from the group consisting of a polysilicon layer, a TiN layer, a Ti layer, or a combination layer made of two or more of these three materials.

16. The method of claim 14, wherein the trench is completely filled by the support layer such that the auxiliary strut has a columnar shape.

17. The method of claim 14, wherein the support layer has a first surface exposed through the second side of the membrane forming thin layer, and part of the first surface of the support surface is recessed such that the auxiliary strut has a "U" shape.

18. The method of claim 14, wherein step (d) is performed after forming the auxiliary strut.

19. The method of claim 14, wherein step (c) further comprises:
forming a protection layer on inside walls of the trench; and
forming the support layer over the protection layer.

20. The method of claim 19, wherein the protection layer is made of a material selected from the group consisting of a Ti layer, a TiN layer, a silicon nitride layer, or a combination layer made of two or more of these three materials.

21. The method of claim 20, wherein the support layer is made of a polysilicon layer.

22. The method of claim 19, wherein the trench is completely filled by the support layer on the protection layer such that the auxiliary strut has a columnar shape.

23. The method of claim 19, wherein the support layer has a first surface exposed through the second side of the membrane forming thin layer and part of the first surface of the support layer is recessed such that the auxiliary strut has a "U" shape.

24. The method of claim 19, wherein step (d) further comprises removing the substrate and the oxide layer near the protection layer such that the membrane forming thin layer is exposed.

25. The method of claim 14, further comprising:

(e) forming an aperture which penetrates the membrane forming thin layer to form a projected pattern on the pattern areas of the membrane areas.

26. The method of claim 25, wherein step (e) is performed after forming the main and auxiliary struts.

27. The method of claim 25, wherein step (e) is performed before
5 forming the main and auxiliary struts.

28. A method of manufacturing a stencil mask, the method comprising:
preparing a silicon on insulator (SOI) substrate by layering sequentially a
substrate, an oxide layer and a silicon thin film;
10 forming a first mask pattern over the silicon thin film;
forming a trench by etching the silicon thin film, the oxide layer, and the
substrate using the first mask pattern as an etching mask;
forming an auxiliary strut by filling the trench with a support layer;
forming a second mask pattern on a surface of the substrate which is
15 opposite a surface of the substrate which contacts the oxide layer;
forming a main strut which limits a membrane area of the silicon thin film
by etching the substrate using the second mask pattern as an etching mask; and
forming an aperture which penetrates the silicon thin film to form a
projected pattern inside a pattern area limited by the auxiliary strut in the
20 membrane area.

29. The method of claim 28, wherein the first mask pattern is formed of a hard mask pattern and a photoresist pattern covering the hard mask pattern.

30. The method of claim 28, wherein the substrate is etched in step
5 (c) to a first depth that is less than the total thickness of the substrate.

31. The method of claim 28, wherein the support layer is made of a material selected from the group consisting of a polysilicon layer, a TiN layer, a Ti layer, or a combination layer made of two or more of these three materials.

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32. The method of claim 28, wherein the trench is completely filled with the support layer such that the auxiliary strut has a columnar shape.

33. The method of claim 28, wherein the support layer has a first
15 surface exposed through the silicon thin film, and part of the first surface is recessed such that the auxiliary strut has a "U" shape.

34. The method of claim 28, wherein step (d) further comprises:
forming a protection layer on inside walls of the trench; and
20 forming the support layer over the protection layer.

35. The method of claim 34, wherein the support layer is made of a material selected from the group consisting of a Ti layer, a TiN layer, a silicon nitride layer, or a combination layer made of two or more of these three materials.

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36. The method of claim 35, wherein the support layer is made of a polysilicon layer.

37. The method of claim 34, wherein the trench is completely filled by the support layer on the protection layer such that the auxiliary strut has a columnar shape.

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38. The method of claim 34, wherein the support layer has a first surface exposed through the silicon thin film and part of the first surface is recessed such that the auxiliary strut has a "U" shape.

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39. A method of manufacturing a stencil mask, the method comprising:
(a) preparing a silicon on insulator (SOI) substrate by layering sequentially a substrate, an oxide layer, and a silicon thin film;

(b) arranging a border area which limits plural membrane areas that have pattern areas and non-pattern areas placed between the pattern areas in the silicon thin film;

5 (c) forming an aperture which penetrates the silicon thin film to form a projected pattern in the pattern areas;

(d) forming a first mask pattern which covers the pattern areas having the aperture and the border area and exposes the silicon thin film in the non-pattern areas;

10 (e) forming a trench by etching the silicon thin film, the oxide layer and the substrate using the first mask pattern as an etching mask, in the non-pattern areas;

(f) forming an auxiliary strut by filling the trench with a support layer;

(g) forming a second mask pattern on a surface of the substrate which is opposite to a surface of the substrate which contacts the oxide layer; and

15 (h) forming a main strut which limits the membrane areas in the border area by etching the substrate using the second mask pattern as an etching mask.

40. The method of claim 39, wherein the first mask pattern is made of a hard mask pattern and a photoresist pattern covering the hard mask pattern.

41. The method of claim 39, wherein the substrate is etched in step (e) to a first depth that is less than the total thickness of the substrate.

42. The method of claim 39, wherein the support layer is made of a material selected from the group consisting of a polysilicon layer, a TiN layer, a Ti layer, or a combination layer made of two or more of these three materials.

43. The method of claim 39, wherein the trench is completely filled by the support layer such that the auxiliary strut has a columnar shape.

44. The method of claim 39, wherein the support layer has a first surface exposed through the silicon thin film and part of the first surface is recessed such that the auxiliary strut has a "U" shape.

45. The method of claim 39, wherein step (f) further comprises:
forming a protection layer on inside walls of the trench; and
forming the support layer over the protection layer.

46. The method of claim 45, wherein the protection layer is made of a material selected from the group consisting of a Ti layer, a TiN layer, a silicon

nitride layer, or a combination layer made of two or more of these three materials.

5 47. The method of claim 46, wherein the support layer is made of a polysilicon layer.

 48. The method of claim 45, wherein the trench is completely filled by the support layer on the protection layer such that the auxiliary strut has a columnar shape.

10 49. The method of claim 45, wherein the support layer has a first surface exposed through the silicon thin film and part of the first surface is recessed such that the auxiliary strut has a "U" shape.

15 50. A stencil mask comprising:
 a membrane forming thin layer having membrane areas and a border area that limits the membrane areas;
 a main strut formed on the border area of the membrane forming thin layer that supports the membrane areas; and

an auxiliary strut formed inside the membrane areas that divides the membrane areas into a plurality of divided membrane areas and supports the plurality of divided membrane areas.

- 5 51. The stencil mask of claim 50, further comprising a plurality of apertures formed in the membrane areas.